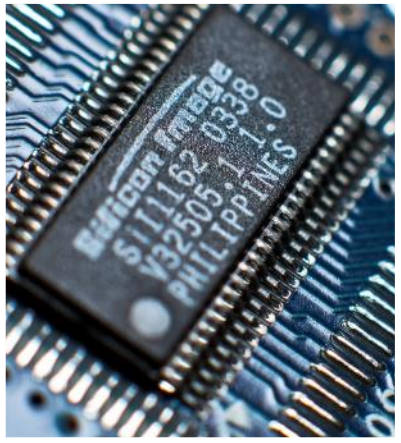




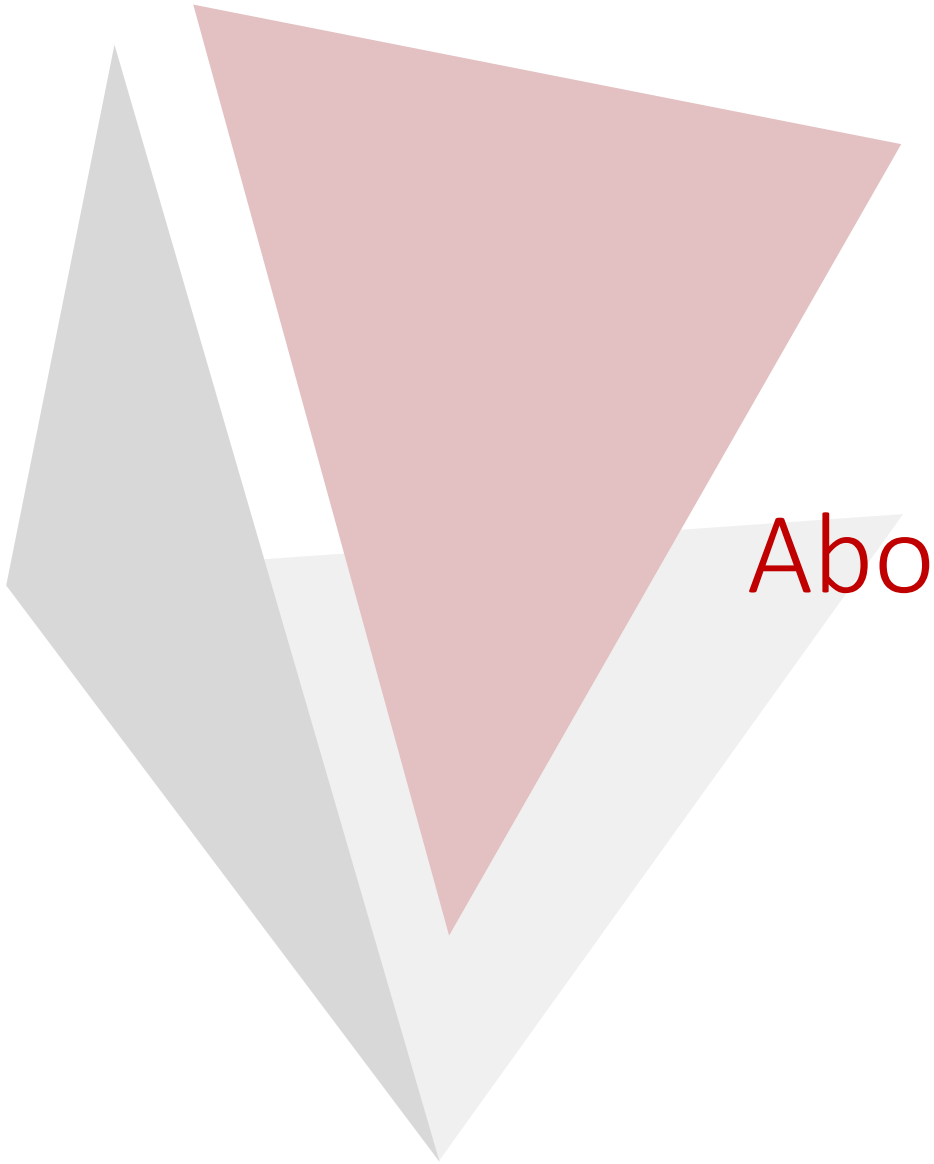
VECTOR software

Change impact analysis and change-based testing for embedded software

Michal Jablonski 3/5/2017





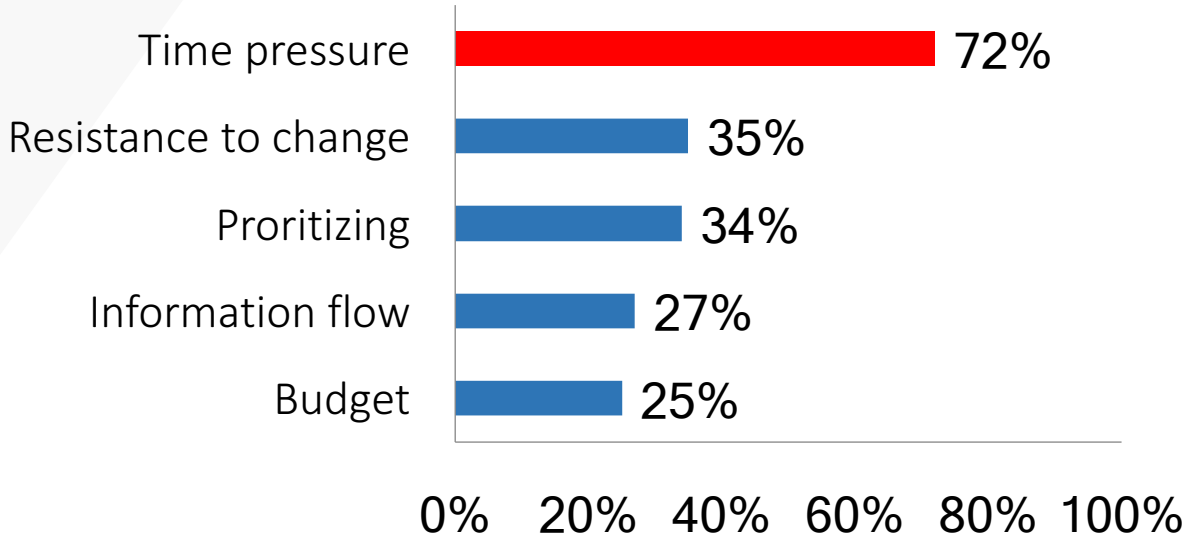


About Vector Software

Organizations world-wide use our test automation platform to reduce the development time, risk, and cost of delivering reliable, secure, and compliant software.

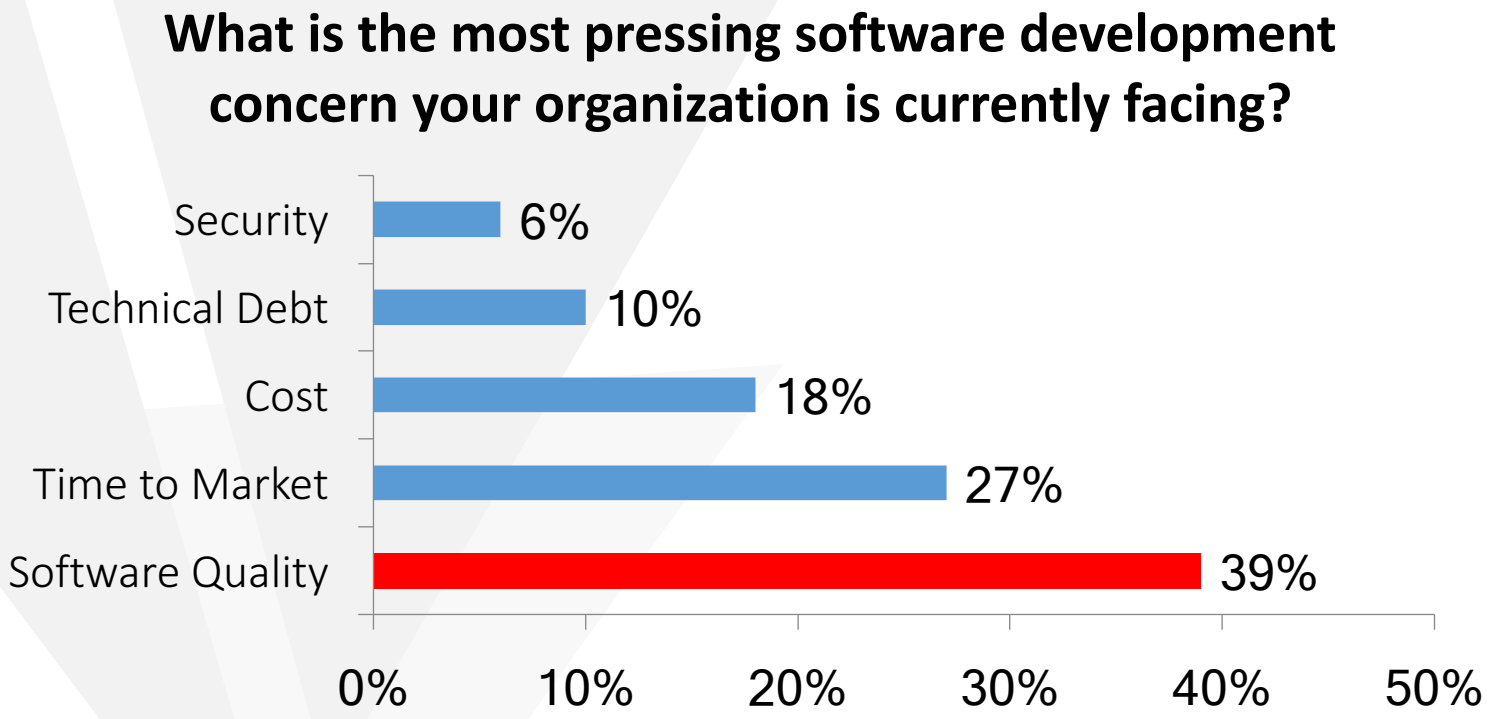
What development challenges does your organization face?

- Time pressures to release new products / upgrades to market
- Resistance to change in established development processes
- Prioritizing features / development initiatives
- Lack of information sharing within the development organization
- Lack of budget



Source: 2016 Software Testing Technology Report (VectorSoftware, 224 responders)

What is the most pressing software development concern your organization is currently facing?



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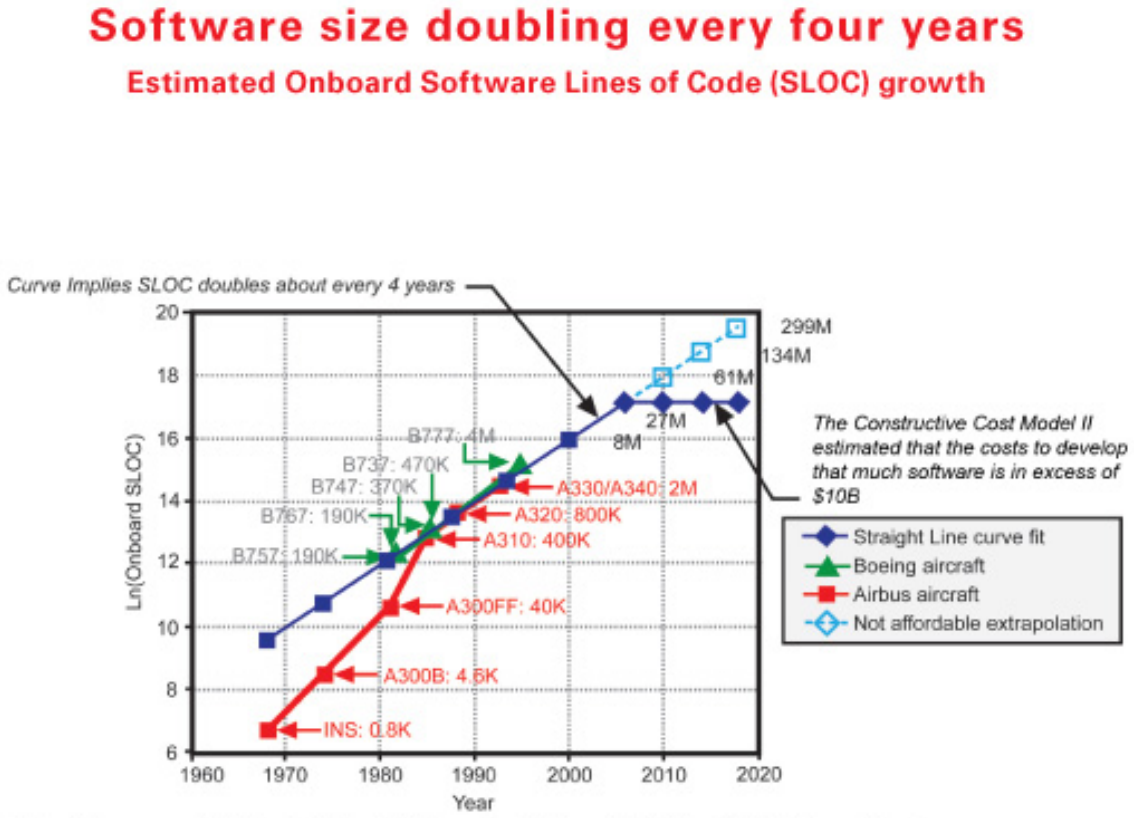
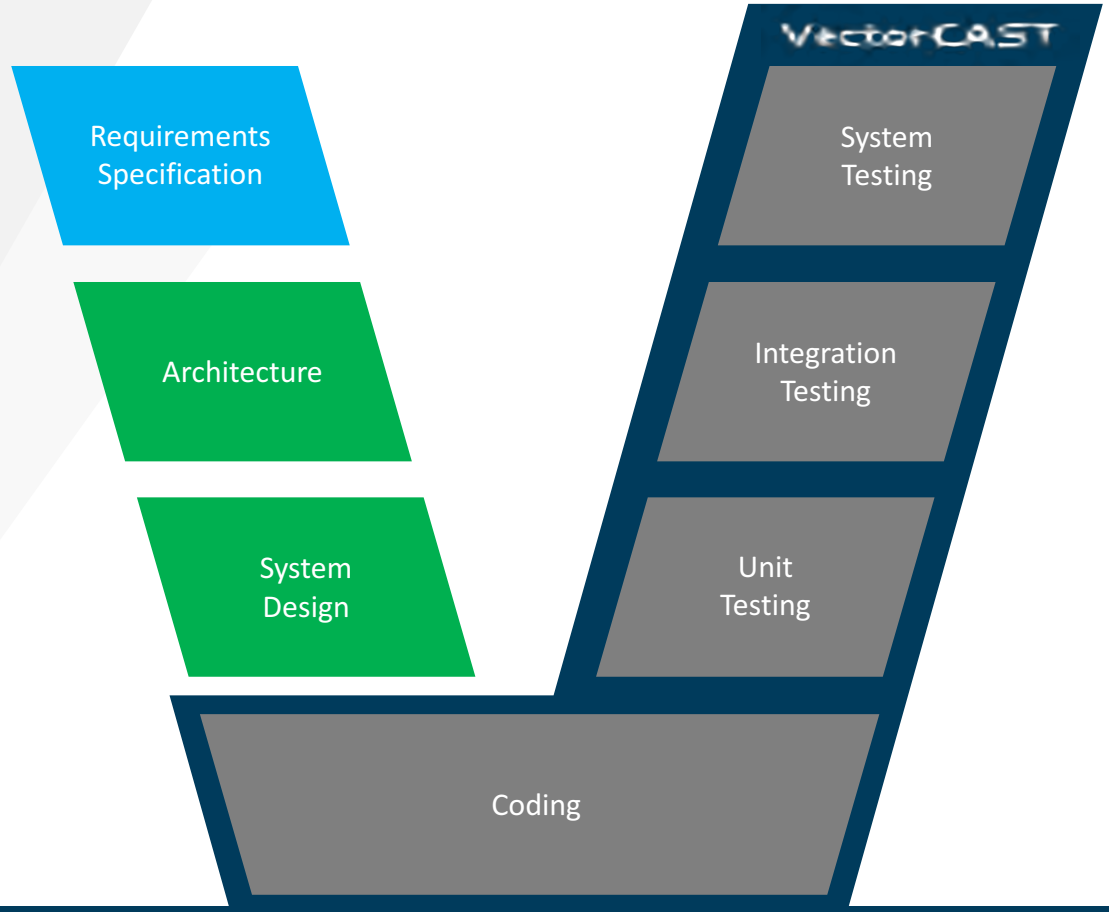
Can we allow same number of defects per SLOC?

- „Developing software for embedded systems is not getting any easier or less expensive. Since systems offer more functions, code size grows… checking that code becomes a challenge.”
  Gartner (Hype Cycle for Embedded Software and Systems)
- Does #bugs grow with #SLOCs?
- Some other examples:
  - 787 Dreamliner – 7M SLOC
  - Airbus A380 – 100M SLOC
  - Ford F150 – 150 M SLOC



How to improve Software Quality

- Can testing improve Software Quality?
  - Testing does not improve quality directly
  - Testing can set the benchmark for your state of quality
- **Testing** together with good **metrics**, **KPIs** and **quality gates** can prevent bug slippage



Choice : quality or time to market?

How can change base testing help us?

How often test software?

Phase of the S/W Dev	Relative cost to fix a bug*
Maintenance	100x
Testing	15x
Implementation	6.5x
Design	1

Testing Phase	~Cost/Bug**
System Test	$5000
Integration Test	$500
Full Build	$50
Unit Test	$5

- As soon and as often as possible!
- Find any bug in early stage = reduce the cost of fixing the bug
- How often is often and can we do it even more often?

* DevOps: Shift left with continuous testing by using automation and virtualization (IBM; Dibbe Edwards)
** How Google Tests Software (James A. Whittaker, Jason Arbon, and Jeff Carollo)

How VectorCAST tests VectorCAST?

- Many different test campaigns
  - Unit Testing
  - Integration Testing
  - System Testing
  - Requirement Testing
  - …
- Three different OS supported
  - Windows, Linux, Solaris
- 300+ compliers configuration supported
  - IAR, Keil, Code Composer, Renesas, Visual Studio,….
  - Running on host, simulator and targets
- Resulting in over 36K test cases.

Software - Change Process

- Software developer changes code
  - Bug fixes
  - New features
  - Requirement changed
- Code Changes need to be tested
  - Unit, integration, system – testing
- Execution of all test cases in all configurations is impossible
  - Code change is system tested in one configuration
  - Maybe unit tested in one configuration
- Due to runtime Integration tests are executed only once per week or month
  - Issues found in integration testing need to be traced back to the responsible SW developer
  - Responsible SW developer needs to understand the problem and fix the bug
- If not all configurations are tested or no integration test is established the customer will find the bug after product release

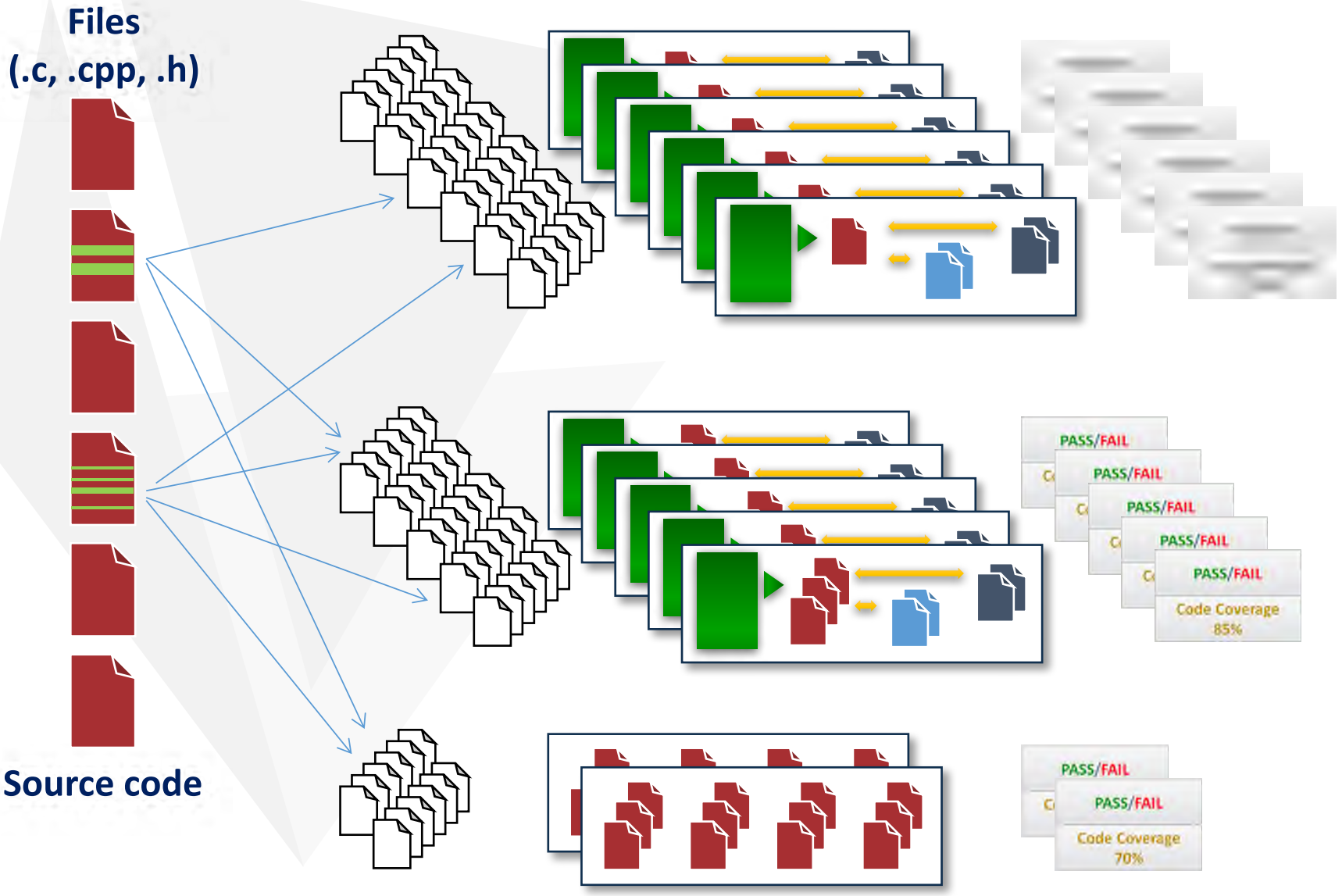
What is change based testing?

- Execute test cases based on source code changes
  - The test management system needs to be aware which code changed
    - *This can be archieved e.g. using a time stamp or a checksum*
  - Test case needs to be associated with source line of code
    - *This can be archieved e.g. using code coverage analysis*
- Only re-build test environments where the source code changed
  - Many unit-, or integration– test environments are not affected by the code change
- Only execute test cases that are affected by the code changes
  - Even inside one file only some functions have changed
  - In most cases you don‘t have to execute all test cases on that file
- Requirement changed
  - Fail all the test cases linked with the changed requirement
  - Require the user to „visit” affected test cases.

Change Base Testing simulation

Source code change

What Test Environments need to be rebuilt?

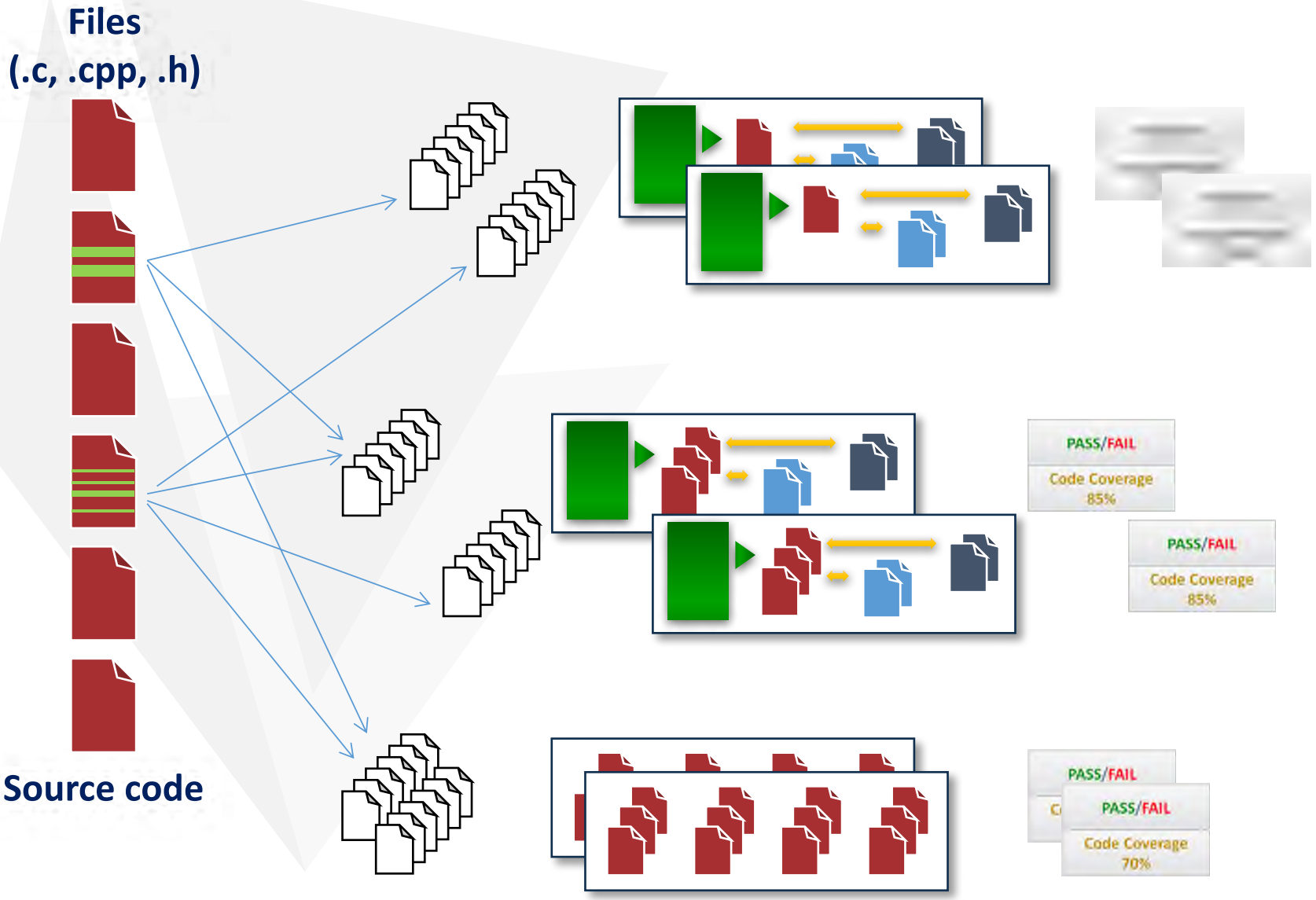


Unit Tests Environments

Integration Test Environments

System Test Environments

What Test Cases need to be executed



Unit Test Environments

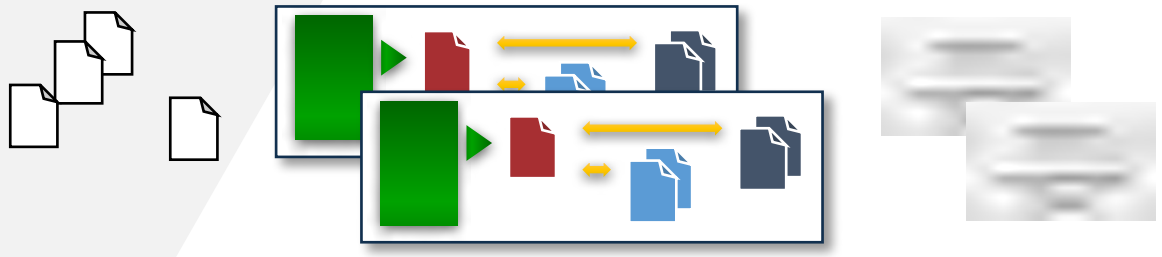
Integration Test Environments

System Test Environments

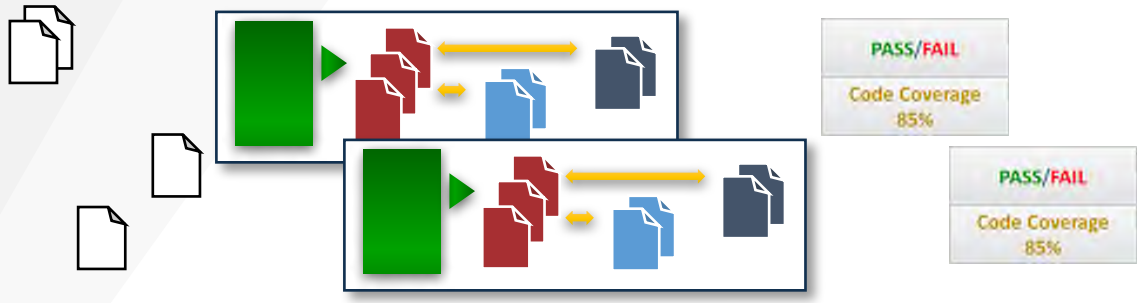
What Test Cases need to be executed

Files
(.c, .cpp, .h)

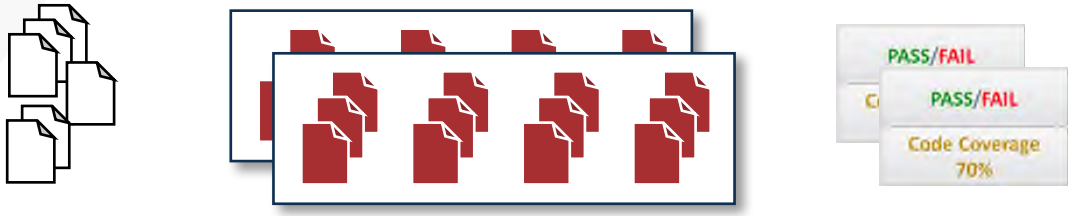
Source code



Unit Test Environments

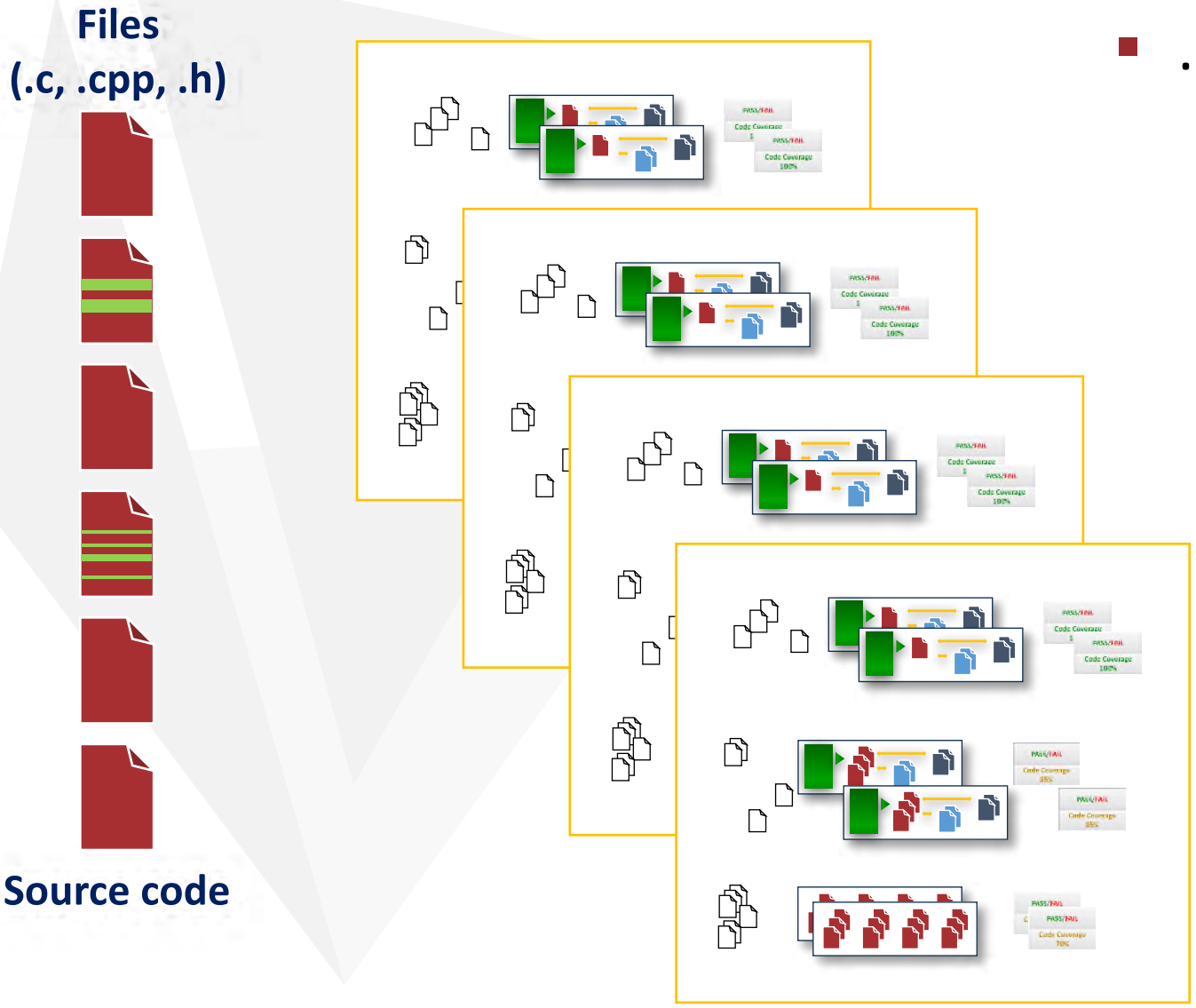


Integration Test Environments



System Test Environments

Regression Testing in all Variants...

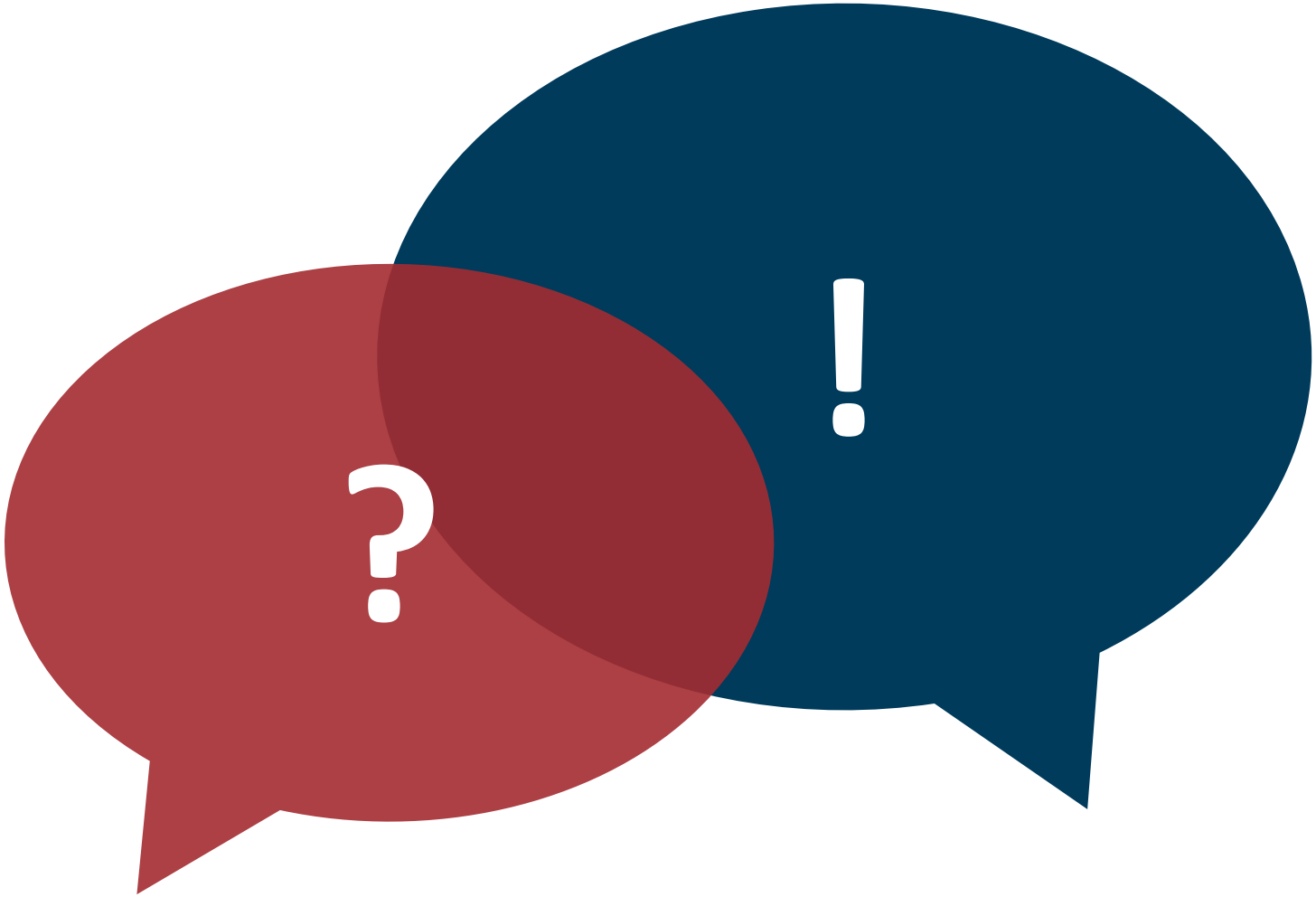


- ...is now possible
  - Reduced number of environments that have to be built
  - Reduced number of test cases
  - Change based test selection has to be done in each configuration

Change Based Testing benefits

- Reduced test execution time
- Allows the developer to execute all! (necessary) test cases before check-in
- No integration test errors that show up after weeks
- Improvement of infrastructure utilization
- Improvement of time to market
- Quality improvements

Questions and Answers



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